GAS JOURNAL, MAY 17, 1944

VOL. 243 96th YEAR No. 4226

EDITORIAL NOTES

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AS we went to press last week we were informed of the decision of the Council of The Institution of Gas Engineers to cancel the arrangements provisionally made for holding the Annual Meeting in Edinburgh next month, and we were just in time to announce the bare fact on p. 590. We sympathize with the President, Mr. Jamieson, and his Scottish colleagues that such a decision should have to be made. We realize that it will be a matter of keen disappointment. But in view of the current war situation cancellation of a two-day meeting of engineers holding key positions in the various undertakings of a vital public service and at a time of such grave intensity can only be regarded as wise and, indeed, inevitable; and we think there can have been little surprise at the course taken. Many, we know, had asked themselves whether, in spite of the obvious value of a gathering of the kind, and however much they wanted to support the President both as President and man, their journey would in fact in the current circumstances have been absolutely necessary, and whether, indeed, it could be justified in the national interest at this juncture of the war. Many, we know, had come to a decision on this point which tallies with the step which the Council of the I.G.E. has reluctantly but, we suggest, very wisely taken. We ourselves very much doubt whether the prestige of the Institution or of the Gas Industry in general would have been at all enhanced by a two-day meeting in the immediate weeks ahead. Public reaction, we imagine, would not have been favourable. So in June gas engineers will remain at their posts, the while, as we have said, extending their sympathy to Mr. Jamieson and to Scotland. What could be more pleasurable to anticipate than a visit to Edinburgh in a peacetime June? Such thoughts, however, are hardly compatible with present stark reality, and it is far better to face facts than be sorry.

GAS INSTALLATION PRACTICE

AMONG the first of a series of Post-War Building Studies to be published by the Ministry of Works is that of "Gas Installations," being the report of the Committee of The Institution of Gas Engineers convened at the Ministry's request. The object of the Studies scheme, to the progress of which we have referred from time to time in these columns, is to secure a comprehensive and co-ordinated review of building technique for the guidance of those responsible for the direction and organization of building after the war. The I.G.E. Committee in question was charged with a review of existing information and practice concerning installations for the supply of gas for all purposes from the point of entry of the gas to the property boundary to its delivery to an appliance, and of gas-operated household appliances serving the single family dwelling. It was asked to consider proposals for improved gas appliances for space heating, cooking, refrigeration, hot water supply, and clothes washing and drying, and to make recommendations for post-war practice. This important task was obviously, from the terms of reference alone, no light one, but it was tackled resolutely and carried through energetically and with commendable speed. The document just published—veritably a first-in-the-field report—covers the general ground admirably and concisely, and it should be in the hands of every gas engineer and manager. Comprised of 40 odd pages, it is obtainable from H.M. Stationery Office. The detail is in print for all to read and study, and we intend to confine ourselves to a few general comments only.

Proper co-ordination at the outset of all concerned in the design and erection of buildings is of the greatest importance, and in the past such co-operation has all too often and in far too many directions been conspicuous by its absence. In the initial stages there should be consultation between the architect, the engineers concerned, and all others responsible for the various services. It is in the interests of all that building specifications should show that services can be provided at all points where they may reasonably be required. Lack of systematic advance planning for services in buildings has meant the adoption subsequently of methods at once expensive, inconvenient, and architecturally undesirable. Where no provision has been made damage has resulted to walls and floors and so on, and the occupier has been put to totally unnecessary inconvenience. Towards this proper co-ordination the present report should help very greatly. The recommendations are thoroughly sound and well based, and though the report is addressed to the Minister of Works, it seems to us to be also in the nature of an appeal to the Gas Industry as a whole for a more unified and a higher standard of gas installation work generally. The intention, we learn, is that from it a booklet shall be compiled by the Gas Industry giving amplified explanatory notes on the matters referred to in it, for use of the Industry's technical personnel.

It is, then, what may be termed a "basis report," the recommendations of which will form the starting-point of Codes of Practice. Six drafting panels have been set up by the Institution, each panel dealing with a specific subject, and already a number of draft codes has been prepared. When approved by the Institution they will be passed on to the Codes of Practice Committee of the Ministry of Works. The next step is publication by the British Standards Institution, the authority behind them being that of general acceptance rather than of any Government Department. Codes may be incorporated in contracts or even ultimately, form part of statutory enactments, though this latter is not the objective at the moment. We have spoken of the speed with which the report under review has been prepared. It should be mentioned that in point of fact the work was not started *de novo*, but was really a logical continuation of previous comprehensive work of the Gas Installations Committee of the I.G.E.

We have referred to the expense and inconvenience which inevitably result in the absence of co-ordination between the architect and builder and those responsible for fuel services. There is another aspect of the matter, and that is the principle of freedom of choice of fuels by the tenant, who, if the services have been adequately planned, is enabled not only to satisfy individual preferences but also to make use of technical and economic developments in fuel supply. The normal expenditure of a family on fuel forms so considerable a part of the total outgoings that the cost of providing the facilities for full benefit to be derived from this expenditure is not disproportionate. In a normal dwelling-house the total cost of fuel used in the house during its life equals or exceeds the cost of the house itself, and the provision of a complete installation of gas pipes and points, in addition to facilities for the use of electricity and solid fuel, is surely a reasonable standard of equipment in house construction. We would not hazard anything like an exact statement of the increased cost incurred as a result of having to install a supply of gas after the building has been completed instead of at the time of construction. But it will certainly be about three times as great, and may be much more than that.

The I.G.E. Committee rightly points out in the report that both the installation and the design of gas appliances have in the past frequently been marred by the fact that in the majority of cases they have had to be installed either as additions to existing solid fuel appliances—take, for instance, a gas fire added to a coal grate—or they have had to be fixed in positions which were not primarily or adequately designed for the

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reception. If certain provisions are made, whatever form of fuel is finally selected, the appropriate type of appliance could be installed without causing unnecessary alteration or leading to incongruity. The Committee has recommended that the Standards Committee of the Ministry of Works should give careful consideration to this matter in consultation with the gas, electrical, and solid fuel industries, with a view to determining suitable locations and dimensions for domestic fuel appliances—for example, suitable dimensions of fireplaces—which would result in the harmonious fitting of appliances for any fuel service at the choice of the occupier. If dimensions were standardized, the number of sizes of gas, electric, coal, coke, or other solid fuel appliances could be limited, and one type of appliance could easily be changed for another without upsetting design details. Actually the Committee, in conjunction with the other fuel interests, has consulted the Sub-Committee on Design of Houses and Flats of the Ministry of Health, and has submitted proposals for the location, dimensions, and installation of fuel appliances in new buildings.

As we have said, the contents of the report (which, by the way, includes a section on "bottled" gas installation) should be known by every gas undertaking. The suggestions in it are thoroughly practical, and the report as a whole appeals to us as a working guide to good installation practice. We shall be pleased to obtain a copy at the Stationery Office and post it to any reader who sends us 8d.

Gas Advisory Committee

From the very nature of its work, this Committee, formed just a year ago, could not be expected to seek much publicity for its doings. If, however, it was able to render an account of its first year's stewardship, we believe the Gas Industry would find lively cause for satisfaction in what has been accomplished. We believe, too, that the Ministry of Fuel and Power has shown full appreciation of the availability—so to speak at an hour's notice—of such a representative and authoritative consultative committee of the Industry. The composition of the Committee for the ensuing year is recorded in the report (see next column) of the National Gas Council C.E.B. We learn that at the first meeting of the newly elected representatives Dr. Evans, the first Chairman, expressed the view that the chairmanship should circulate among the members, rather than become vested in any one individual. This excellent proposition found acceptance, with the result that Mr. A. E. Sylvester was elected Chairman by his fellow members.

Personal

J. R. W. ALEXANDER, M.A., LL.B., F.C.I.S., Barrister-at-Law (Associated Gas and Water Undertakings, Ltd.), has been co-opted a member of the Council of the Chartered Institute of Secretaries, the membership of which exceeds 12,500.

* * *

Mr. ROBERT COWIE, sen., who has been Manager of the Hawick Gas Company for the past 18 years, is retiring for health reasons at the end of this month.

* * *

Mr. J. H. BOOTH, Managing Director of the Winsford Gas Company, and Engineer and Manager of the Middlewich Gas Company, has been co-opted as a member of Winsford District Council.

* * *

Mr. A. F. OATLEY, Director of Cannon Iron Foundries, Ltd., has been appointed Joint Managing Director.

* * *

Mr. L. K. POTTER, invalided from R.A.F., will shortly resume his work with R. & A. Main, Ltd., in the West of England.

Obituary

The death occurred on May 13, at the age of 85, of Sir WILLIAM GURNEY BENHAM, F.S.A. Sir Gurney Benham had been a Director of the Colchester Gas Company for over forty years, for 27 years as Chairman, and had attended a meeting of the Board to tender his resignation on account of failing health only on Friday, the day before his death. He was born in 1859 and was educated at Merchant Taylors' School. He took a prominent part in the public life of Colchester, serving as Councillor and Alderman for over fifty years and three times as Mayor. For sixty years he was proprietor and editor of the *Essex County Standard*. He was twice married, and leaves three sons and three daughters. One of his sons, Major G. C. Benham, M.C., is a Director of the Colchester Gas Company.

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Letter to the Editor

The Question of Tariffs

DEAR SIR,—Reading Mr. Pallister's Address there is a point which interests me very much. It is the second "illustration" he gives in the early part of the Address—*viz.*, "The advantages . . . of a low basic price gas available to all and free from complicated tariffs which the consumer does not like and cannot understand."

Against this we have the passage in the Post-War Planning Report of the Institution of Electrical Engineers: "The two-part tariff has so many advantages as compared with the flat rate per unit that every effort should be made to secure its universal adoption. . . . The Electricity Commissioners might be given powers to direct the few that do not to offer such a tariff."

They go further. Recognizing that to secure the full effect the two-part tariff should be universally adopted, they suggest that the Commissioners "might be given powers to approve any undertaking offering a two-part tariff only with no alternative flat rate," subject to regulations to secure that no consumer should have to pay more than a specified maximum during the period of account, this specified figure to be normally the flat rate for lighting, which is generally pretty high. The fact is, of course, that domestic consumers like and fully understand the two-part tariff when properly presented to them.

Yours faithfully,

May 12, 1944. "PRICE-APPEAL."

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on May 9, at Gas Industry House. The Chair was taken by Mr. Frank H. Jones (Vice-Chairman). The Chairman, on behalf of the Board, welcomed Mr. J. Wesley Whimster, of Bath, who had been appointed to represent the South-Western District in place of Colonel R. L. Norrington.

The Annual Report of the Council for the twelve months ended March 31, 1944, having been circulated, was considered and approved, with one minor amendment.

In view of the fact that some of the Districts had yet to hold their annual meeting, the question of the Chairmanship of the Central Executive Board was postponed until the next meeting of the Board.

A report on the general coal position was received. It was reported that at the meeting of the Coal Committee of the Conjoint Conference held on April 21, Mr. Ogilvie had been asked to follow up the questions of short weight due to non-repair of railway wagons, and colliery weights clause. A committee had also been appointed to assist Mr. Ogilvie in the preparation of a Memorandum in connexion with the price of coal, for submission to the Coal Controller.

A Resolution received from the National Gas Organizations in Scotland expressing intense dissatisfaction with the uniform Pit Price Scheme for Coal in Scotland was reported, and it was agreed that the complaint from Scotland should be included in the Memorandum from the Conjoint Conference.

A vote by ballot resulted in the appointment of the following representatives to serve as members of the Gas Advisory Committee for the ensuing year: Col. W. Moncrieff Carr, O.B.E., T.D.; Dr. E. V. Evans, O.B.E., F.I.C.; Mr. A. W. Smith, C.B.E., F.C.I.S.; Mr. A. E. Sylvester, F.C.A.; Mr. S. E. Whitehead, B.Sc., M.Inst.C.E., M.I. Mech.E., J.P.

Dr. Evans reported the proceedings at a meeting of the Committee held the previous day. Among the matters discussed at that meeting were: Labour, restriction by Order of the Ministry of Fuel and Power on gas consumption by industrial concerns, and additions to Defence Regulation 57A(*a*), relaxing the Regulation governing calorific value, purity, and pressure.

A meeting of the Emergency Committee of the Conjoint Conference had been held on April 21 with regard to—

(a) *War Damage*.—It was pointed out that although the Government White Paper on War Damage to Public Utility Undertakings had been issued in November, 1942, no legislation had yet been introduced. A reasoned letter had been sent by the Conference to the Treasury, urging that the requisite legislation be introduced as soon as possible, and asking when it might be expected.

(b) *Cost of Extension of Mains*.—It was stated that a meeting between representatives of the water interests, the electricity interests, and Mr. Ogilvie representing the gas interests, had been arranged to take place at the Ministry of Health on May 12, in order to clarify the position and find out exactly what was intended by the circular entitled "Advance Preparation of Housing Sites" (No. 14/44) issued by the Ministry of Health, dated Feb. 21, 1944.

Income Tax Committee.—A meeting of the Income Tax Committee held on May 4 was reported.

Reference was also made to the important concessions which the Chancellor of the Exchequer had announced with regard to depreciation in the post-war period.

It was agreed to hold no meeting of the Board in June, but that the next Board Meeting should take place on July 11, at 2 p.m.

The Outlook for Juniors

Colonel C. M. Croft, Junior Vice-President of The Institution of Gas Engineers, initiated an informal discussion on the outlook for junior gas engineers at the annual general meeting of the London and Southern District Junior Gas Association at Gas Industry House on May 12. The ordinary rules of debate were suspended, and members availed themselves of Colonel Croft's invitation to express themselves with perfect freedom on the subject which he believed interested most of them, namely, having qualified, how were they going to get on, and what was their target to be?

Quoting at random from "Appointments Vacant" advertisements in the "JOURNAL," Colonel Croft said some of the salaries offered were, to say the least, scandalous, and he wondered how the tremendous amount of work people had done in qualifying in The Institution of Gas Engineers could be brought home to the undertakings responsible for such advertisements. Unfortunately there were people who would apply for such jobs in any circumstances, but everyone who applied was letting down a dozen or more other men who had qualified but who would not apply for those jobs. So long as people did apply it was very difficult to raise the status of the qualified gas engineer, and he would be glad to have the views of members of the Association on that matter.

Conditions differed considerably between northern and southern undertakings, and there were great differences between municipal and company-owned undertakings. Under a corporation, the Town Clerk was paid a minimum salary, and so was the Medical Officer and the Surveyor, but the Gas Engineer was getting only what they liked to pay him. The trouble about trying to establish a minimum salary was that it tended to become the maximum, and in the end the lot of the gas engineer was no better than before. The only sensible course seemed to be to aim at setting up a professional level, and to advise members not to apply for those jobs which appeared to be underpaid. Unqualified assistants were not going to be of much use to any undertaking, whatever their salary.

He believed that in the area of the London Juniors there were few if any municipal undertakings, but when he spoke in Scotland a few months ago he found practically all the juniors were in corporation works, and he had heard it said that whether or not a man remained at his job depended to a great extent on whether the council or the town clerk liked him. Politics must be kept out of such matters. The technical level and the standard of knowledge in gas engineering was being raised to a higher level than ever before, and to attain responsible positions the juniors had not only to pass examinations, but to show that they could perform their duties satisfactorily.

In some quarters there was a feeling that the larger the company the more difficult it was to progress to the higher positions, because the individual was liable to become lost in the multitude, but speaking for his own undertaking he could say that was not the case; they were always particularly careful to see that no one was overlooked. Some people seemed to think that because they were qualified they were capable of progress, but personality and the ability to control personnel represented probably as much as 60% of the job.

There was no sort of standard about the salaries of assistants from, say, 21 upwards. In considering promotions, it had to be remembered that the manager of a department in a big undertaking often had just as good a job as the manager of the smaller works He had just as much freedom, and probably a much larger salary, than the man at the small works. There was no doubt about the bigger pay at the larger works, but there was a chance of being overlooked when promotions were considered. He was giving the whole matter very close study, and he would welcome the views of the members.

In the discussion that ensued, reference was made to an enquiry on salaries carried out by the Southern Association of Gas Engineers and Managers a few years ago, but no one appeared to have heard whether there was any outcome. Equal pay for equal work was desirable, but two men with equivalent qualifications serving undertakings of an entirely different size could not very well expect to get the same rate of pay. The electrical people were said to have classified their people much more precisely than the Gas Industry had done, with the result that it was much easier to establish rates of pay for specific duties. The tendency to lower pay in municipal undertakings operated in some cases in electricity as well as gas departments, though generally speaking, with the more precise classification the pay was rather better than in the gas departments.

There was general agreement that the Gas Industry would have to face up to the two-fold problem of attracting back into the Industry those who had gone out into wartime occupations, and of attracting the young men of the future. One suggestion that found considerable support was that there should be a more extensive interchange of juniors in order to widen their experience. Loyalty to one's own undertaking was liable to be exaggerated, and it would be all to the good if young men could go round to small, medium, and large works, spending a few months in each. This involved the question of standard salaries, as young men could not be expected to lose by moving, and the position was further complicated by the higher cost of living in London compared with the provinces.

Without formulating any set resolution, the meeting agreed that the whole outlook should be surveyed on the lines of Colonel Croft's opening remarks. Colonel Croft promised that if the Association gathered up all the information it could on the subject he would look favourably upon the invitation to come again in a few months' time and talk the matter over with them.

The Annual Business

Mr. B. W. Dawkins presided over the annual meeting, at which Mr. S. J. Gibbons, Hon. Treasurer, reported a total membership of 504 (of whom 91 were in the Services), compared with 495 a year ago.

The President said the Association had to some extent reverted to its pre-war programme, with successful results in spite of wartime restrictions, and the Papers presented during the session had been of a high order. Much useful work had been done by the Joint Council, one result of which was that they would enjoy more complete affiliation to The Institution of Gas Engineers. The Association now also had definite representation on the Council of the Eastern District of the Southern Association, and similar facilities were to be extended by the Western District to the Western Junior Gas Association.

The election of officers and council for the 1944–45 session resulted as follows:

President.—Mr. R. F. Twist (South Metropolitan Gas Company).
Senior Vice-President.—Mr. L. W. Andrew (Gas Light and Coke).
Junior Vice-President.—Mr. G. G. Warne (Portsmouth).
Hon. Treasurer.—Mr. S. J. Gibbons (Gas Light and Coke).
Hon. Secretary.—Mr. C. A. Deas (Tottenham).
Hon. Assistant Secretary.—Mr. J. E. Gray (Gas Light and Coke).
Hon. Auditor.—Mr. G. Wilson-Smith (Gas Light and Coke).
Members of Council.—Messrs. L. A. Clarke, D. A. Johnstone, J. E. Gray, J. Anderton, R. J. Pepper, T. S. Ricketts, F. C. Smith, and T. V. Garrud, with Mr. W. A. Howie and Mr. J. M. Webber *ex-officio*, representing the Southern Association.
Representatives on District Education Committee.—Messrs. R. W. Latham, R. F. Twist, L. W. Andrew, and C. A. Deas.

Votes of thanks were accorded to Dr. J. N. Long, for the use of the Westminster Technical Institute, and to the Press.

Institute of Fuel

Dr. E. W. Smith was the chief guest at the annual luncheon of the Midland Section of the Institute of Fuel held in Birmingham on April 29. The retiring President of the Section, Dr. C. M. Walter, Birmingham Gas Department, occupied the chair.

Responding to the toast of the guests, Dr. Smith pointed out that the war had postponed the possibility of the Institute obtaining a Charter, but steps were being taken to give it the status which it would thus have attained. They were trying to satisfy the community that here was a body which could be relied upon; one of their primary functions should be to make the community fuel conscious, so that there could be a better utilization of fuel, and they should act as propagandists in that respect. Immediately they did that they required funds, and a number of industrialists had offered to contribute to a guarantee fund to be used to assist the Institute rapidly to extend its activities. It was believed that the Institute had justified its existence, and that they had a right to ask for subscriptions to a guarantee fund of £5,000 to £10,000 a year to enable a success to be made of the work. They had hardly started, but they had already had an encouraging response. The justification for this scheme was that they were not going to duplicate the work of any other institution. They were in the fuel industry to fill up the gaps and to bring the other bodies together if possible. They would be a co-ordinating body that could, if necessary, suppress its own individuality and give a lead to other bodies.

Mr. L. F. Jeffrey (Chief Engineer, West Midlands Joint Electricity Board) was elected President for the ensuing year.

Diary

May 19.—Association of Gas Corporations: Council, Gas Industry House, 2.30 p.m.
May 20.—Yorkshire Junior Gas Association: Royal Victoria Station Hotel, Sheffield, 2.30 p.m.
May 24.—B.C.G.A.: Annual Meeting of Members in Scotland, North British Hotel, Edinburgh, 2 p.m.
May 25.—Midland Junior Gas Association: Visit to the works of John Wright & Co., Ltd. (Radiation Ltd.), Aston, Birmingham, 4 p.m.
May 25.—Lancashire and District Coke Association: Annual General Meeting, Engineers' Club Rooms, Manchester, 11.30 a.m.
May 26.—B.C.G.A.: Domestic Heat Services Committee, Gas Industry House, 2 p.m.
May 28.—Scottish Junior Gas Association (Eastern District): Annual Meeting, Heriot-Watt College, Edinburgh.
May 31.—Eastern Counties Gas Engineers' and Managers' Association: Spring Meeting, Connaught Rooms, Kingsway, W.C. 2.
June 2.—Gas Research Board: Joint Committee on Methane Synthesis, Gas Industry House, 2 p.m.
June 5.—Association of Gas Corporations: General Purposes Committee, 2.30 p.m.; Council, 3.30 p.m., Gas Industry House.

Work of the Gas Research Board

Report of the Director

A SECTION of the 4th Annual Report of the Council of the Gas Research Board (GRB Publication No. 8) contains short statements by Dr. J. G. King, O.B.E., the Director on each of the active research programmes. Since this is the first occasion upon which this has been done, each statement has been prepared in the form of a review which brings the progress of the investigation up to date in October, 1943. The section also includes statements regarding other researches of direct interest to members, such as, for example, those carried out in the laboratories of members of the Joint Committee on Methane Synthesis, in industrial laboratories in collaboration with the Director, or by Committees and Research Fellows of The Institution of Gas Engineers.

During the year under review nearly all the research work has been carried out, as formerly, at Leeds University, under the immediate direction of Dr. Dent and the general supervision of Professor Townend. Dr. Dent has paid special attention to gasification in oxygen and steam, hydrogenation under pressure and methane synthesis, Dr. Key to the influence of pressure on the steam/carbon reactions and the purification of gases from organic sulphur, and Mr. Wood to preliminary experiments on the purification of synthesis gas under pressure and the combustion characteristics of coal gas. The remainder of the staff have helped on all programmes. A research assistant has been attached to Prof. Sir Alfred Egerton's team working on the production and use of liquid methane.

Complete Gasification

The systems of complete gasification which have been tried in this country have so far been associated with the production of gas of low calorific value. The obvious method of producing gas of the same order of calorific value as town gas is to use oxygen, and the possibility of introducing cheap oxygen into the processes of the Gas Industry has been discussed many times, particularly after the development by the Lurgi Gesellschaft für Wärmetechnik m.b.H. of a pressure-generator to work on brown coal, using a steam-oxygen blast and pressures " of several atmospheres." In this process the hydrogen and oxides of carbon produced in the lower part of the fuel bed have been held to react above, and with carbon, so that methane is synthesized. With increase of pressure the reactions $C + 2H_2 = CH_4$ and $2CO = CO_2 + C$ both move to the right and, since the second reaction cannot be inhibited, the crude gas contains a high percentage of carbon dioxide (about 30%) which must be removed. Since the gas is produced under pressure this can readily be done by washing with water without incurring further compression costs. The advantages shown by the Lurgi process are a high output per unit cross-section of the generator (2,400 cu.ft. per sq. ft. per hr.) and a gas calorific value of the right order. Using dry brown coal a gas of 450 B.Th.U. per cu.ft. can be obtained at a yield of 185 therms per ton, consuming 15 cu.ft. of oxygen and 7 lb. of steam per 100 cu.ft. of finished gas.

During 1937 the Joint Research Committee decided to examine the possibility of gasifying British coals in the same way. The reactions in the lower half of the generator were studied first* by obtaining data on the interaction between oxygen and steam and coke, between the limiting ratios of $H_2O/O_2 = 3.0$ and 13.4. These experiments provided data regarding this reaction and the probable composition of the gas which would react in the upper part of the generator. Then, in order to study the reactions of the upper part of the generator without the limitation of having to carry out the first series of reactions at the same time, studies were made of the action of synthetic gas mixtures and of nitrogen and hydrogen upon coke and coal.†

Using a low-temperature coke containing enough volatile matter (20%) to yield hydrogen and methane corresponding to 2.3 and 14.7 therms respectively per ton when distilled in a stream of nitrogen, it was found that the action of hydrogen brought about a greatly enhanced yield of methane. For example, at a reaction temperature of 800°C. methane production proceeded to the following extents at pressures varying from 1 to 100 atmospheres:

Pressure (atmospheres)	...	1	5	10	50	100
Methane (therms per ton)	...	33.8	92	133	276	312

The course of the reaction was an absorption of hydrogen in the early stages, followed by the appearance of methane at about 500°C. and an accelerated formation at 700° to 750°C. Very similar results were obtained with other low-temperature cokes and some coals. One theory for the production of methane in this way is interaction at the surface with $-CH_3$, $>CH_2$ or $\gtrless CH$ groupings. In the case of the example quoted above, the assumption that all the hydrogen was combined as $\gtrless CH$ groups would indicate a possible yield of 430 therms of methane per ton. However, in one experiment the calculated yield of methane was greatly exceeded, indicating that disruption of the graphite crystallites must also take place, probably during the period of accelerated formation at 700° to 750°C. All these results show that the methane is not formed solely by the interaction of hydrogen and carbon monoxide as had been supposed.

At reaction temperatures above 800°C. the carbon is broken down further and still higher yields of methane are obtained (500 to 600 therms at 900° to 950°C.), the calorific value of the gas being over 500 B.Th.U. and over 90% of the coke being gasified.

Experiments with other cokes have indicated that satisfactory interaction with hydrogen could not be obtained if the carbonizing temperature of the cokes were too high. It was possible, however, to obtain high yields of methane from coke carbonized at a temperature as high as 800°C. provided the temperature of interaction with hydrogen was appreciably higher—*e.g.*,900° C. At this temperature and using a pressure of 50 atmospheres of hydrogen it was indicated that the carbon of coke could be gasified to the extent of 70% and, with alkali-activation, to 100%.

With coals of high volatile matter the first zone of accelerated rate of formation of methane is more pronounced for obvious reasons, since it corresponds with the period of active liberation of the volatile matter. The second zone coincides with the accelerated formation of hydrogen, observed when coal is heated at atmospheric pressure and first pointed out by Wheeler.* In both zones it follows that the condition of thermal instability of (*a*) side-chains and (*b*) carbon and graphite crystallites leads to high rates of formation of methane, hydrogen liberation being inhibited.† In addition to gaseous hydrocarbons the action of hydrogen produces a yield per ton of about 30 gall. of a "primary" tar which should be particularly amenable to further hydrogenation treatment.

In all these experiments a 1-in. diameter tube was used in which the caking of the coal did not appear to matter. It was realized, however, that development to a larger reaction vessel would have to be approached cautiously, paying special attention to the effect of caking of the mass and to the control of the heat of reaction. In a 4-in. tube, passing the hydrogen down through 1 kg. of coal, interaction with fusion and a very rapid rise of temperature takes place and passes as a zone down the charge. In this size, blockage caused by caking did not yet become a disturbing factor, but it did become so when the diameter of the vessel was increased to 6.5 in. With caking coals it then became necessary to separate the fines and charge these down the walls, leaving the pieces of coal in the middle. Water-cooling of the walls was also helpful. Under these conditions it was possible to treat all types of coal and all low-temperature cokes, the reaction zone passing through the 12-in. charge in 5 to 10 min. Neither the water jacket nor sizing was necessary with semi-cokes and coals which had been specially rendered non-caking.

These observations upon the action of hydrogen upon coals rather altered the course of the research, and systems suggested themselves for processes involving more than one stage, but with the action of hydrogen upon coal as one stage. It was realized that difficulties would be involved in the control of caking and in the control and utilization of the heat of reaction, and several alternative schemes have been worked out to overcome these. The ideas have been protected in nine patents and one further application. The next step was to design an apparatus of larger size to examine the mechanism of the process upon a larger scale. This apparatus or semi-scale plant has been designed and should soon be completed, ready to start work. The reaction vessel is 14 in. in diameter and the charge of coal about 300 lb.

The results to date of this research may be summarized as follows:

(i) Coals and semi-cokes can be converted to gaseous and liquid hydrocarbons by the action of hydrogen under pressure. The reaction is strongly exothermic for both coal and coke.

(ii) In the case of coal the reaction, once initiated, travels rapidly through the coal, achieving carbonization at a very high rate. The yield of gaseous hydrocarbons exceeds 100 therms per ton (total gas 250 therms); liquid hydrocarbons are also obtained in high yield and are of a "primary" character. The coke is finely porous and highly reactive.

(iii) The process may be combined with others, for example, with one involving the production of hydrogen by the pressure-gasification of coke, or part of it, with oxygen and steam in a Lurgi generator, or with a process of methane synthesis from gaseous mixtures containing hydrogen and carbon monoxide, or with a process involving the sale of the reactive coke and the production of the necessary hydrogen by the breakdown of part of the rich gas made. All these will be explored after the gasification of coal with hydrogen under pressure has been achieved on the 300-lb. scale.

Action of Steam and Carbon Dioxide on Carbon

In the course of a laboratory study of the reactions occurring during gasification under pressure, those of steam and carbon dioxide on coke have been the subject of close examination. It was found that the high pressure did not in general increase the velocity of the

* *Trans. Inst. Gas Eng.*, 1936–37, **86**, 133.
† *Ibid.*, 1937–38, **87**, 231.

* *J.C.S.*, 1910, **97**, 1917; 1911, **99**, 649.
† *Trans. Inst. Gas Eng.*, 1938–39, **88**, 150.

reactions, as the following results for comparable conditions, other than pressure, show:

Coke used.	Steam Decomposed, % at—	
	1 atm.	50 atm.
High-temperature coke A at 1,000° C. ...	44	54
High-temperature coke B at 900° C. ...	45	34
Medium-temperature coke C at 900° C.	58	37
High-temperature coke A 5% Na_2CO_3 at 800° C....	52	32

Moreover, the reaction fell off very quickly along the length of the coke column. Exactly the same phenomena were shown in the gasification of coke by carbon dioxide. In addition, in the case of steam, the presence of hydrogen in the steam caused a most marked diminution in the rate of reaction.

These facts, taken together, admitted of no explanation on the basis of any simple mechanism of reaction, although Key and Cobb had found that at atmospheric pressure the ordinary unimolecular law, with appropriate allowance for the water gas reaction when steam was present, was strictly obeyed. It was now shown, however, that in the case of the carbon dioxide reaction, results over the whole range of pressures and depths of fuel bed investigated could be accurately explained if a two-stage mechanism of a certain type were postulated. The first step in this mechanism is the production from the carbon dioxide of one molecule of carbon monoxide in the gaseous phase and one atom of oxygen held on the surface of the carbon. The second step is the removal of this oxygen from the surface as a second molecule of carbon monoxide, thus gasifying an atom of carbon. Both stages are, of course, reversible, and occur at different rates with different cokes.

The accuracy with which this mechanism accounts for the reaction over a wide range of conditions is shown in the following table, which refers to the action of carbon dioxide on a coke at 900°C. The calculated and observed values for the percentage of carbon dioxide decomposed are compared:

Pressure, atm.	Carbon Dioxide Decomposed, %	
	Observed.	Calculated.
1	33.5	34.8
5	35.6	35.8
25	27.3	26.9

A corresponding mechanism, when applied to the steam reaction, immediately explained the known similarity of that reaction with the carbon dioxide reaction and, moreover, accounted for the retarding effect of the presence of hydrogen and for the appearance of carbon dioxide among the reaction products. Quantitative treatment, though difficult because of other reactions supervening, was attempted, and it was quite plain that the two-stage mechanism satisfied the observed facts. This is shown by the following table, which has reference to a high-temperature coke gasified at 1,000°C.:

Pressure.	Gasifying Medium.	Steam Decomposed, %	
		Observed.	Calculated.
1	Steam	32	38
1	80% steam, 20% hydrogen	23	26
50	Steam	49	48
50	80% steam, 20% hydrogen	37	33.5

This work has shown that more than one factor is involved in the gasification of cokes in steam and carbon dioxide. It has also indicated how the constants governing the successive stages for any coke may be evaluated. A more extensive study might well give a better understanding of the differences between cokes, and lead to new methods of obtaining cokes of very high or very low reactivity.

Synthesis of Methane

Methane can be synthesized from a mixture of carbon monoxide and hydrogen using any of the known methane-forming catalysts, particularly nickel and cobalt. The reaction begins at about 200°C. and is very active about 350°C., giving complete conversion of the carbon monoxide at a high space velocity of the order of 5,000. The catalyst is, however, affected by the presence of sulphur, and the reaction gases must be purified to less than 0.1 gr. of sulphur per 100 cu.ft. Also the reaction is strongly exothermic, and special precautions are necessary to dissipate the heat of reaction so quickly that the catalyst temperature does not rise unduly. If it does, the catalyst rapidly loses activity by sintering, and by carbon deposition brought about by the breakdown of carbon monoxide. Control has not proved difficult in the laboratory but a careful study of the mechanism of the reaction has been necessary, in order that the best choice of conditions shall be made for use with plant in which relatively large catalyst columns have to be controlled.

The concentration of methane in the finished gases (after removal of CO_2 and water) depends upon whether equilibrium conditions have been reached. In judging the life of catalysts it is usual to start under conditions which just allow equilibrium to be reached; loss of activity is then measured by the rate of fall of concentration of the chief end-product, in this case methane.

In this case, however, there is evidence to show that the catalyst has initially many times the activity necessary for the attainment of equilibrium. A rapid departure from such equilibrium would generally mean that experimental conditions had led to overheating. Using a gas mixture of H_2/CO ratio = 3, the equilibrium concentrations of CH_4 in the dry, CO_2-free gas are as follows:

Temperature, C.	Equilibrium Concentration, % at—		
	1 atm.	5 atm.	25 atm.
350	80	88	95
450	59	73	84
550	35	55	71
650	15	33	54

Methane content and calorific value, therefore, increase with decrease of temperature and with increase of pressure. If a town gas of 500 B.Th.U. were aimed at (say, 30% CH_4) the maximum temperatures employable could be 570°, 665° or 783°C. at pressures of 1, 5 or 25 atmospheres, respectively.

The investigations now in progress form part of the general programme on gasification, but have also special significance as follows:

(*a*) They form part of one system for the treatment of coal with hydrogen under pressure wherein the hydrogen, which would contain some carbon monoxide, would be treated by catalysis to synthesize some methane before being used for the treatment of the coal, thereby reducing the amount necessary from the coal to give an average gas of the required calorific value. Synthesis of methane in this way has the advantage referred to later of being conducted under pressure whereby a high temperature can be used and the tendency towards sulphur poisoning reduced. Also the combination would allow of the full utilization of the exothermic heat of reaction in raising the steam necessary in the production of the process hydrogen.

(*b*) They form a means of producing methane from coke (CO and H_2) which would be alternative to that of the gasification of coal with hydrogen under pressure. This would lead to greater control over coke production, but would have an even greater importance if liquefaction of methane should become a commercial process.

(*c*) Research work has not been limited to high pressures, since a low-pressure synthesis could have immediate application in the Gas Industry, and since it was considered wise to explore a wide range of operating conditions.

Work at Gas Research Board Laboratories

A preliminary exploration has indicated that a nickel catalyst made in a simple but effective manner is likely to give a satisfactory rate of conversion at a high space velocity. The behaviour of the catalyst has been explored at various temperatures with special reference to the influence of (i) composition and sulphur content of the synthesis gas, (ii) temperature upon sintering, (iii) rate of flow of gas, (iv) addition of steam, (v) re-circulation of gases, (vi) diffusion of gas at the catalyst surface, and (vii) the dimensions of the catalyst bed.

In the case of a granular catalyst and the passage of gas at atmospheric pressure, a low reaction temperature (350° to 500°C.) led to loss of catalyst activity and to deposition of carbon. Both have been shown to be due to the development of a high surface temperature where the reaction gases come first into contact with the catalyst. The rate of loss of activity is increased by a decrease in the ratio H_2/CO, and in practice it may be necessary to employ a ratio above 1.20.

The addition of steam counteracts the tendency to form carbon from the carbon monoxide and also, under certain circumstances, prevents loss of catalyst activity caused by sintering. Re-circulation creates the same effect by reducing or controlling any undue rise of surface temperature. A shaped or rod catalyst arranged to lose heat readily by radiation also helps to control the surface temperature. Making use of these expedients it has proved possible to operate the simple nickel catalyst at any temperature within the range 350° to 800°C. and at any pressure within the range of 1 to 50 atmospheres, and it is believed that carbon deposition can be avoided. There still remains, however, a fundamental problem to study the mechanism of carbon deposition from gases containing carbon monoxide and hydrogen. This will be investigated in due course in order that a full knowledge of the mechanism may serve as an insurance against possible future difficulties.

So far, demonstrations of the ultimate life of the catalyst have not been made owing to the greater necessity for investigating optimum conditions. Experiments which have had to be discontinued because of the long times involved have, however, shown clearly that long periods of activity are attainable without any measurable loss of activity. The following are four examples:

	(1)	(2)	(3)	(4)
Length of catalyst column, in. ...	6	48	8	8
Temperature, ° C.	450	450	650	800
Pressure, atm.	1	1	20	50
Vols. of gas per catalyst, vol. per hr....	1,500	2,000	7,000	7,000
Methane, per cent.	60	55	55	40
Duration of experiments, days ...	60	30	60	90

Gas was re-circulated in experiments (1) and (2).

The problem now remains of making the best choice of conditions for trial on a semi-technical scale. The design of the apparatus requires careful study in order to remove and utilize the heat of reaction in the best practical way, whether by conduction by a thermal fluid or by the convection of circulating gases through the catalyst bed, or by other means. The experimental work is now at this stage.

(*To be continued*)

High-Pressure Storage and Distribution*

By B. G. HAWKINGS, Plymouth and Stonehouse Gaslight and Coke Company

WITH the growth and development of urban areas the need for transmission of gas over comparatively long distances has greatly increased. Furthermore, the inception of regional gas distribution schemes and attendant centralization call for a much greater use of storage and high-pressure distribution. Therefore it is evident that the future will hold great scope for the development of high-pressure technique in gas distribution.

In numerous instances a high-pressure system with no storage, where the capacity at existing conditions of plant has been reached, may be given a new lease of life, economically, by the employment of storage at strategic points. This is due to the very nature of the loading of modern gas distribution systems, where the load factor is an extremely poor one. It is difficult to envisage greatly differing load conditions, even in the future, although, of course, it is always an engineer's aim to improve his load factor on all plant. As long as the Gas Industry retains the bulk of the domestic cooking load, the cooking period peak will remain with us, since it is the one load that cannot be spread over a longer period. Hence, however much we improve our basic load by increased use of gas for space and water heating, we shall still have the cooking load superimposed on it. Of course, this statement applies purely to systems with little or no industrial loading, the type of system with which I propose to deal.

It is obvious that with increased distances over which gas must be transmitted, the initial pressure utilized at primary distribution centres must increase. This leads to a pressure nomenclature suggested by the Author as follows:

Low pressure . . .	Up to 1 lb. per sq. in.
Medium pressure . .	From 1 lb./sq. in. to 5 lb./sq. in.
High pressure . .	,, 5 lb./sq. in. to 100 lb./sq. in.
Extra high pressure .	Over 100 lb./sq. in.

An undertaking in the South-West was faced with the problem of replacing a length of 6 in. steel high-pressure feeder main some four miles to cope with increasing peak demands, or, alternatively, to introduce storage at a country town at the terminal end of the feeder. Comparing overall costs of a main of sufficient capacity to cope with increasing peak loads over a period of years and storage to cover these loads over the same period, it was found that the most economical solution would be the adoption of storage. H.P. storage was finally adopted, since it was found to be more economical than L.P. storage. It has the advantages, too, of requiring less ground space, minimum foundation work, minimum material in construction, and minimum attention and maintenance. Furthermore, the relief offered to a high-pressure network by this means need not be limited, as in the case of a low-pressure district holder. Of course, offset against this is the need for compressing plant with attendant maintenance and running charges, and re-distribution regulator.

Briefly, the H.P. storage system consists of the following plant: Two horizontal cylindrical holders with hemispherical ends, each storing 50,000 cu.ft. of free gas at 100 lb./sq. in. pressure. One two-stage Bryan Donkin compressor direct coupled to a 40 b.h.p. slip ring induction motor, capable of handling 10,000 cu.ft. per hour at a final pressure of 100 lb./sq. in., and a re-distribution Reynolds two-stage regulator, delivering 75,000 cu.ft. per hour at pressures from 0–12 lb./sq. in. with inlet pressures varying from 0–100 lb./sq. in. Provision was made when the installation was first erected (when only one holder was installed) to add one or two extra holders of identical size with connexions for an extra compressor. Since then it has become necessary to increase holder capacity, and at the present time plans are being evolved for a further increase in storage, by the addition of another holder unit. An alternative drive for the compressor is furnished by a Daimler sleeve-valve petrol motor developing 48 b.h.p. at 1,100 r.p.m., purchased second-hand from a local omnibus company, this machine being housed alongside the two-stage compressor.

Although provision is made for automatic working of the storage station, it is regularly hand controlled. The storage station also comprises the local district showroom and branch office, with a staff of fitters controlled by an inspector, always in attendance. Since it has been found essential by reason of district requirements to vary the loading of the re-distribution regulator when in use once a week, on Sundays, and to increase the terminal pressure on the feeder to the holder station when charging holders, to overcome pressure drop, it is considered more desirable to dispense with the automatic equipment for the present. Attendance to the plant is maintained by the resident inspector in the course of his normal daily duties, except on Sundays, when his time is wholly and solely occupied by attendance to the re-distribution and district regulators. Operating costs and other charges are shown in Table I of the Appendix.

The period of operation of the re-distribution regulator on Sundays is approximately 2–2½ hours, when the compressors at the manufacturing station supplying the high-pressure system are run at a base load depending on the seasonal requirements with a maximum of 170,000 cu.ft. per hour. At a point approximately half-way between the works compressors and the holder station, a branch connexion supplies another section of the high-pressure system, and to maintain a satisfactory minimum pressure at the terminal end of this section, pressure at the branch must be varied according to load requirements of the section in the 2–2½-hour period. This variation is effected by loading of the regulator at the high-pressure storage station, where a distant pressure indicator gives visual indication of pressure conditions at the branch, and hence release of gas from stock is adjusted simultaneously. This rate of loss of stock at times of maximum demand closely approximates to the peak load of the district normally served by the high-pressure feeder—*viz.*, 45,000 cu. ft./hr. An indicator at the works compressor room looped-in on the same circuit synchronizes with the distant pressure indicator at the storage station. Therefore the works compressor attendant can also effect some measure of pressure control at the key branch point, should the reduced stock position at the storage station become serious due to extraordinarily heavy demands. A table of holder stock figures at pressure intervals of 1 lb./sq. in. from 0–100 lb./sq. in. is maintained in the compressor room for reference by the attendant.

The original distant pressure indicator giving pressure conditions at the terminal end of the high-pressure feeder to the district in which the storage station is situated is naturally retained at the works compressor room. This system of communications forms a most invaluable link in the whole chain of distribution control, and undoubtedly is wellnigh indispensable, therefore it is maintained accordingly. A telephone system imposed on the stock indicator circuit completes the comminications system between manufacturing station, branch connexion, and storage station.

The scheme has worked satisfactorily over several years, and has prevented many a headache to those confronted with distribution problems directly and indirectly due to the present state of hostilities. Its chief utility in this direction lies in the ability to shut down primary plant while effecting repairs or alteration to mains and plant.

There is no question that in the future, when we once more hope to see the Gas Industry striding forward, this high-pressure storage plant will still be giving yeoman service, smoothing out distribution difficulties on the whole high-pressure network of the undertaking.

Modern High-Pressure Technique

Undoubtedly, where a number of districts or communities have to receive a supply of gas through a high-pressure system, unless these districts are attenuated in one direction from the supply station and are fed from one direction only, an endless or ring supply system has obvious advantages. Of course a system consisting of one straight feeder, fed at each end, is almost identical with a ring system. Therefore it follows that with the probable adoption of regional schemes in post-war planning, the ring system of high-pressure distribution should be most common.

Furthermore, with the increased practice of parcelling or sectioning of erstwhile large governor areas or districts into multiple smaller districts on low-pressure supply systems forced on distribution engineers by conditions of total warfare, the stage is already set for distribution by medium pressure through trunk feeders, and then *via* district regulators to looped or ringed low-pressure districts of comparatively small size. In the Author's opinion this is an ideal method of combating the bogy of wide pressure variation, if we are to endeavour to adopt the standards set by the Institution's Committee on Gas Quality.

The technique of cast iron pipe manufacture has so improved over the last 10–15 years that it is possible now to employ spun-iron pipes in the transmission of gas at medium and high pressures with complete safety. Closely associated with improvement in pipe manufacture is the increased development of flexible joints for use with spun iron pipes ; in fact, transmission of gas at high pressure by cast iron pipe is equally dependent on an efficient flexible joint as on improved pipe material. Overall laying costs of the cast iron material are undoubtedly less than with steel material, and unless severe shock and stressing are encountered, a cast iron main forms an admirable pipeline.

In the Author's opinion, where long lengths of pipe-run are contemplated, such as in the development of a new high-pressure system, sections of main passing through congested urban areas should be run in steel material, and sections of main passing through rural areas in cast iron. It is fair to state that stressing of pipelines should be greater in built-up areas where the traffic density is high compared with that obtaining in rural areas. Connexion of steel pipes to cast iron pipes is an extremely simple affair, effected by the use of a combination of flange and flexible joints. Where steel pipes are laid over railway bridges and there is need for an expansion joint, the type of joint exemplified by the Johnson coupling is strikingly simple and efficient. This joint is exceptionally useful also in the insertion of specials and valves in existing steel pipelines. Up to the present, however, this is only borne out by the result of small-scale practical experiments carried out at Plymouth in the last few months. The results of others are pending. It is essential that all high-pressure

* From a Paper to the Western Junior Gas Association, March 25.

pipelines laid now and in the near future be tested to a minimum of 75 lb. per sq. in., since no doubt can then be expressed should the pipeline be called upon to form part of a distribution network transmitting gas at much higher pressures than are now encountered in this country. This is the practice now carried out at Plymouth, and complete confidence is placed in the tested pipelines of their ability to stand up to greatly changed conditions expected in the post-war era.

I do not propose to say very much about the corrosion of pipes, as it is outside the scope of this Paper, but the problem does loom large in the minds of distribution engineers. The long life of cast iron pipes is well known, due in large measure to the increased bulk of material forming the pipe, but instances have occurred to my knowledge where steel pipe, inadvertently unprotected, has been in extremely good condition after burial for twenty years. Most important of the factors bearing on the external corrosion of pipelines is subsoil condition.

Some trouble is still experienced with internal corrosion products in the form of a black dust, which varies in texture from a floury fineness to a sandy coarseness. To prevent this dust entering low-pressure systems fed from the H.P. network, a dust screen is interposed at the inlet to all large regulation installations; this also serves to keep clean the regulators themselves. However, from time to time it is found that dust of the finest grade passes the screens and deposits itself on regulator valve seats, causing the regulators to raise their lock-up or banking-up pressures, fortunately with no dire results. This serves to indicate the fineness of the dust, when it is understood that the screening medium is fine felt. Although partial gas dehydration has been practised at Plymouth for the last twelve years, water is still removed in fair quantity from syphons up to two miles from the compressor house at the works, frequently when intermediate syphons are dry. As analysis of the water has proved that it has not entered the pipeline from external sources other than the gas, it is safe to assume that the dew-point of the gas under the conditions of pressure and temperature existing in the pipeline is not reached immediately at the outlet of compressors. Hence it is possible for internal corrosion to proceed in a H.P. system fed from a source also supplying a L.P. system which to all appearances is free from corrosion trouble.

The sections of pipeline on which most trouble from black dust is experienced are those on which the gas loads are heaviest and where the most turbulent conditions exist in the pipeline. Heavy surges are also allied causes of dust pick-up by the gas. Where the dust particles attain high velocities it is not unfair to assume that erosion of the corroded internal surfaces of pipelines takes place; this can be accounted for by the degree of fineness of dust removed at terminal points. Dust removed from intermediate and earlier points in the gas stream invariably contains a greater proportion of dust of larger grading.

In the construction of dust screens it is essential that the bearing surfaces of the removable filter unit should be a ground or machined fit and should be lubricated, to prevent slip by very fine dust. Provision should also be made that the filtering medium can be removed easily for cleaning, testing, or renewal.

Normal high-pressure distribution practice calls for the employment of section valves at certain regular distances in a straight run of pipe, at the junction of feeders and branch connexions, at the connexions to various types of plant, and railway companies' regulations specify the inclusion of isolation valves in gas mains crossing bridges over their permanent way. Therefore the valving arrangements in any high-pressure network must be complete, and must permit the efficient operation of each valve under any conditions. Particularly is this so under conditions of total warfare. The chief cause of inefficient working of valves and regulators is the deposition of foreign material on working faces and seats.

In the case of district and service regulators or governors, regular attention is given them, whether cleaning is necessary or not, district regulators receiving attention at a maximum period of three months and service regulators six months. At each maintenance visit the regulator concerned is stripped and cleaned, diaphragm and valve leathers are oiled, and then the whole is reassembled. When a regulator is first installed all relevant details such as position, make, size, type, &c., are entered on a history sheet, which is filed. After any visit to a regulator, details of the operations carried out on it are entered on the history sheet, and thus a complete record of the regulator's performance can be found quickly. In the light of experience gained on the maintenance of district regulators, it is essential that where they are installed with dust screens the screen should be removed and examined at least once a fortnight. This obviates the need for the more involved operation of cleaning the attendant regulator at periods less than the normal three months. To facilitate maintenance and to cause the consumer the minimum of inconvenience, all regulator installations supplying more than four consumers consist of two regulators connected in parallel, the stand-by or auxiliary regulator being smaller in size than the normal working regulator. Thus, unless there is a regulator failure no consumer is without gas at any time, and the regulator attendant is relieved of the responsibility of ensuring that all consumers in a group of more than four are informed that they will be without a supply of gas during the period of shutdown for maintenance.

The regulator attendant is also made responsible for the maintenance of stop valves at the inlets and outlets of regulator installations, details of which are entered in the regulator history sheets in the case of service installations, and in the valve history sheets in the case of district installations. Regulator maintenance costs are shown in Table II of the Appendix.

If section stop valves are to operate at maximum efficiency with complete certainty of tight closure, particular attention must be paid to their maintenance. It is not sufficient to go to a valve and operate it through part of its travel, assuming it is in the open position, and then regard it as in good working condition. Unless the full travel of the valve doors is effected with a tight closure at the termination, the distribution engineer is left in a fool's paradise.

In the first instance all valves installed in any high-pressure system should be of the double-faced type, and should be designed with generous regard to facilities for lubrication and cleaning. All valves ordered by the Plymouth undertaking for use on high-pressure lines specify the inclusion of three lubrication or oiling points besides the normal cleaning doors on each valve. Reconditioned valves not possessing oil injection ports are fitted with them in the works' fitting shop, at the time of reconditioning. Apart from the purpose these oiling points serve primarily, they also serve, when employed on double-faced valves, to indicate the degree of tightness when these valves are supposedly closed.

When a valve chamber is constructed, iron pipes are run to a convenient position in the chamber from the oiling points, and terminate in small cocks designed for use with high pressures, the iron pipe sizes being usually $\frac{1}{4}$ in. or $\frac{3}{8}$ in. Two forms of oil injection pump are employed—one of the direct-acting oil pump type, the other made up from an old pattern service cleansing pump, the large bell-shaped air reservoir also acting as an oil reservoir. The first type of pump is used on valves in fair to good operational condition, the second is employed in serious or stubborn cases. A flexible connexion terminating in a union is employed between pump and cock on the oil feed pipes. Charges of oil, up to $\frac{1}{2}$ gallon, are injected into a valve that cannot be closed due to deposition of foreign matter, such as dust or rust on seats and wedges, and an instance has yet to be found where a valve in such a condition has not yielded to patient treatment. In normal circumstances, petrol or light kerosene is used as the cutting or cleansing fluid, since after performing its primary function it evaporates into the gas stream and leaves the valve's internal surfaces dry and clean, thus reducing the tendency for further dust pick-up by oily or sticky surfaces. With the onset of hostilities, however, gas oil was employed as the cleansing fluid, and then eventually the condensate from the high-pressure holders. Details of maintenance costs are shown in Table III of the Appendix.

To enable a valve to be closed in a high-pressure line which is supplied in one direction only, a by-pass is laid across it with a separate control valve included. Depending on the size of pipe to which the by-pass is connected, it is usually run in wrought iron pipe up to 2 in. internal diameter.

Of course, there is practically no limit to the size of by-pass gear that can be laid, but that will depend on the size of feeder and the discretion of the engineer designing the layout, but with the average size high-pressure main in use throughout the country a 2-in. by-pass is a fairly reasonable size. The question may be asked why, on high-pressure lines at time of small demand, cannot a valve be closed for a short period, to determine its condition of operation, without the employment of a by-pass. The answer may be given in a few words. A valve is frequently closed home, or nearly so, and then the operator finds himself in the dismal position of being unable to open it again, and may be inclined to panic, with dire results.

When a valve is by-passed as outlined above, the by-pass should be of such a length as to permit valve renewal if necessary. This can easily be effected, as I will attempt to indicate a little later on. If work has to be undertaken on a high-pressure pipeline necessitating insertion of branches or similar specials, without interruption of supply or purging of sections, and when it is felt that an underpressure clip branch is not desirable, a fine measure of pressure control may be exercised by the operation of by-pass control valves. To carry this operation to a further stage of refinement, tees are included in the by-pass layout, and flexible connexions are taken from the tees and stand-pipes to a portable reducing regulator above ground, the regulator being loaded to any desired condition. It is essential during control of the above nature that the main section stop valve is closed, of course. When the coarser form of control is employed visual results are observed on a pressure gauge connected to the tee on the reduced pressure side of the by-pass assembly.

By the employment of by-passes across all section stop valves forming part of a high-pressure system, whether supplied from one direction or two, gas pressures obtaining in any one section or more may be controlled within wide limits, to enable mainlaying or kindred operations to be carried out without complete cessation of gas flow.

Where section stop valves and attendant by-pass control gear are adopted, it becomes a comparatively easy matter to insert specials in a live section of high-pressure main, by the employment of the Goodman main stopper at the point of insertion, to isolate it from the remainder of the section. Experience at Plymouth has shown that the Goodman stopper can be employed with safety in steel mains up to 8 in. diameter and against gas pressures up to 6 lb. per sq. in. Some difficulty may occur with the use of the Goodman stopper in spun cast-iron pipes with their slightly larger internal diameter, but un-

doubtedly under normal conditions attention to this point during manufacture of the stopper would overcome the matter.

If the special is to be inserted in a pipeline fed from one direction only, a local by-pass can be laid across the points at which the special is to be connected. This, of course, is entirely unnecessary where the pipeline is supplied from each direction. Before the special is inserted the Goodman stoppers are employed in the normal manner, and the pipe is cut where necessary. The special is normally connected to the pipeline by flexible joints readily available from any one of several reputable manufacturers. Removal of stoppers and by-pass then follow, and normal conditions are resumed. It is assumed that prior to the operation of by-passing and insertion the gas pressure in the pipeline has been reduced to a safe working figure.

Where a section stop valve has to be replaced in a pipeline, and connexion to the main has been effected by flanges welded to the pipe, the operation to be carried out is similar in all respects to that detailed above. It is necessary, however, to cut the pipeline a short distance from one flange only, and, when reconnecting, to use one flexible joint at the position of cut. In new pipelines at least one flexible joint should be employed at each valve connexion to facilitate replacement where necessary. Although at first sight it may be suggested that the initial capital outlay is unwarranted, a section stop valve should be fitted at each end of a branch. The distribution engineer is then prepared for any eventuality that may occur in the development and life of the high-pressure pipeline concerned.

Appendix

Due to increased prices of labour and material obtaining at present during hostilities, the following table has been compiled from figures for the first year in which the holder station was complete with two storage units—*viz.*, 1940–41. Figures from several years prior to the outbreak of hostilities are procurable, but refer to the holder station comprised of one storage unit only.

TABLE I.

	£ s. d.
Total cost of installation	5,026 0 0
Estimated capital and depreciation charges (10% total)... ...	503 0 0
Power charge (electricity at 2d./kW.h.)	60 10 0
Maintenance of re-distribution regulator	10 0 0
Compressor and auxiliary drive attendance and lubrication ...	32 5 0
G.P.O. line rentals for D.P. indicators	28 0 0
D.P.I. maintenance	2 15 0
Total	636 10 0
*Volume of gas stored and re-distributed	947,000 cu.ft.
Therms of gas stored and re-distributed	4,262 (C.V. 450 B.Th.U./cu.ft.)
Total gas sold *via* H.P. system	238,000,000 cu.ft. or 1,071,000 therms.
Cost of storage and re-distribution of gas per thousand cubic feet sold *via* H.P. system	0.64d.
Cost of storage and re-distribution of gas per therm sold *via* H.P. system	0.14d.

Note.—The holder units were painted at the time of installation, and had not been repainted up to the time dealt with by this table. No repairs were carried out on the compressor from the time of installation up to 1941, approximately 4½ years. Since the holder units, compressor house, and regulator occupy space within the boundary of previously owned property, no rents or rates are included.

* This figure is not corrected for volume lost due to condensate removal.

TABLE II.—Annual Regulator Maintenance Costs.

Number of district and service regulators in system ...	317
Volume of gas handled by regulators	285,000,000 cu.ft. or 1,197,000 therms.
Wages of regulator attendant and mate	£400
Materials used in maintenance and repairs	65
Operating costs of regulator service van	195
Total	£660
Maintenance cost per 1,000 cu.ft. handled	0.56d.
„ „ per therm handled	0.13d.

The above table of costs refers to a typical year during hostilities over the period from 1941–44.
The C.V. of the gas handled was 420 B.Th.U./cu.ft.

TABLE III.—Annual H.P. Valve Maintenance Costs.

	£ s. d.
Number of section stop-valves in system	64
Consumption of gas on system	285,000,000 cu.ft. or 1,197,000 therms.
*Wages of valve attendant and mate	84 18 0
Materials used in maintenance and repairs	18 0 0
*Operating costs of valve maintenance vehicle	62 8 0
Total	£165 6 0
Maintenance cost per 1,000 cu.ft. gas sold	0.14d.
„ „ per therm of gas sold	0.03d.

* Approximately one-fifth of the working week is devoted to the maintenance of high pressure section valves; the remainder of the week is given over to maintenance of low-pressure section valves, and all syphons throughout the area of supply.

The above figures are given for the same period as in Table II.

DISCUSSION

Mr. **A. Bell** (President) remarked on the charge being made for electricity, and asked for some further explanation of the prohibition of the use of electricity at certain times.

Mr. **Hawkings** said the charge being made and the restriction on the use of electricity arose from the fact that the current was being supplied by a rural supply undertaking in a fairly remote area already fully loaded.

Mr. **A. C. Rea** (Bath) commented on the small volume of stored gas, and said he would have liked a more detailed analysis of cost to indicate why a H.P. storage scheme was preferred. He also enquired if the temperature of the gas at the compressor outlet was measured, and asked for further details concerning the distant pressure indicator and if there was any time-lag in its indications.

Mr. **Hawkings** replied that the storage was only required to carry the system over the peak load and had proved sufficient for this purpose. Other schemes were considered, but as the H.P. main was already existing but overloaded, cost and the convenience of feeding the stored gas back into the H.P. system led to the adopting of the H.P. storage scheme. It had been much less expensive than the relaying or duplicating of the main or the provision of district L.P. storage would have been. The distant pressure indicators referred to were of the Widlake pattern operating over telephone lines leased from the Post Office. There was a slight time-lag between a pressure being attained at the compressors and its indication from the remote end of the main.

Mr. **F. W. Sansom** (Exeter) asked if the Author could give a more detailed description of the type of dust filters employed, and enquired whether any experience could be quoted of extractors working on either the cyclone or oil film principles.

Mr. **Hawkings** said the dust extractors in use employed brass gauge screens to each side of which felt was attached. He had no experience of other types of filters.

Mr. **H. H. Brown** (Exeter) asked whether any analysis had been carried out on the dust met with in steel mains. The colour of this dust had been referred to as varying from light brown to black. Was there any evidence that black dust might be composed largely of iron carbonyl when the percentage of water gas was high?

Mr. **Hawkings** replied that analyses were made by certain eminent chemists some years ago. He did not think they were in agreement in their conclusions. Observations at Plymouth did not indicate any connexion between the presence of black dust and the presence of water gas.

Mr. **O. Pincock** (Weston-super-Mare) asked whether the Author's experience was that one obtained a greater quantity of condensate from C.I. mains than from corresponding steel mains, and if so could he account for it. Also what had he found to be the best method of service attachment to C.I. high-pressure mains, and was any form of service cock utilized on the main?

Mr. **Hawkings** said he had not noticed any greater amount of condensate from cast iron main, and if this was found to be so at Weston he could not account for it. At Plymouth they had used both single and double expansion nipples. They had used the Mueller type of cock on high-pressure services, but were now using double-faced gate valves. All such valves were surmounted with a surface cover for access.

Mr. **S. A. J. Horrod** (Swindon), referring to the condensate recovered from the high-pressure holders, asked whether the smell was not disadvantageous. Also did the condensate removed from H.P. syphons have a strong smell? He further enquired concerning the storage of governor diaphragms.

Mr. **Hawkings** said the use of the condensate from the holders was a wartime measure. It had a very strong smell, and if spilt was likely to give rise to complaints of leakage. The condensate from H.P. syphons was clear water. Diaphragm leathers were stored in tins in a cool dark place.

Mr. **A. G. Holtam** (Cheltenham) described an oil sump type of dust extractor which he had found to be very effective.

Mr. **A. B. Horsfield** (Bristol) proposed a vote of thanks to Mr. Hawkings, this being seconded by Mr. **F. G. Craxford** (Bath).

The Next Meeting of the Yorkshire Junior Gas Association will be held at the Royal Victoria Station Hotel, Sheffield, at 2.30 p.m. on May 20, when a Paper will be read by Mr. W. T. Hird (Sheffield) entitled "Selling a Temperature—Some Observations on the Marketing of Central Heating."

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

Benzole Recovery by Activated Carbon

The following is a report of the discussion on the Paper entitled "Benzole Recovery by Activated Carbon," presented by Messrs. R. Walker, H. C. Applebee, A.I.C., and A. K. Howell, at a meeting of the Manchester and District Junior Gas Association—see "JOURNAL" of March 8, 15, and 22.

The **President** (Mr. H. H. Thomas) said the Manchester Gas Department was among the early pioneers in the adoption of this particular method of using an automatic plant. The plant obviously had been a financial success, even in the circumstances in which it had been worked up to the present. He felt a little disappointed about the way in which the sulphur recovery from the gas deteriorated with the life of the carbon. This was possibly due to the carbon having been used for an abnormally long period, and it would be a matter for later assessment—efficient use of carbon, high benzole recovery, high sulphur recovery *versus*, possibly, a higher cost of carbon due to replacing it more frequently. This was a matter which the Manchester Gas Department would discover by experience. It would finally decide how much it was worth to reduce sulphur, and set that against the amount of benzole it was going to recover. The cost of supervisory labour was included in the cost per gallon of benzole as 0.359d. per gallon. What did it amount to in man-hours per day?

Mr. **R. Walker** (Manchester) remarked that the reasons determining the choice of a particular plant were outlined in the Paper. They embodied the usual criteria adopted in deciding the choice of any chemical or engineering plant. The first consideration, of course, must be the efficiency of a plant. The plant was required solely for benzole recovery; therefore the important point was the efficiency to be expected in the removal of hydrocarbons. Another consideration was whether such efficiency was possible under all normal conditions. What were the prevailing conditions? Could regularity of operation be anticipated? Would there be ease of operation? Had the method advantages so far as the maintenance of the technical conditions was concerned? This latter question was reflected in the automatic character of the operation, and in the advantages, so far as they could be perceived, of the engineering design.

Another point to be considered was the cost of the efficiency. Therefore an attempt had been made to state details of the operating costs, the results being that they appeared to be entirely satisfactory. He was of opinion there was a great advance which had to be recognized in the general engineering layout, and in that respect he desired to pay a tribute of appreciation to Messrs. Sutcliffe, Speakman & Co., Ltd., and particularly to Mr. Edwards, for the assistance rendered in connexion with the work. Mr. Wilkin had also been particularly helpful in regard to the engineering design of the plant, which, of course, was a fundamental consideration. Mr. Wilkin visualized the whole of the carbonizing and by-product recovery process from the point of view of modern approach—namely, automatic simplicity. If other processes could be improved in a similar manner the result would be well worth while in the future.

The general aim of the Paper had been to give the information which had been acquired up to the present time, endeavouring to ascertain what variations occurred in the composition of the products to be expected as the adsorbing capacity was reduced. Another consideration was how far the sulphur removal changed with the varying life of the carbon. The work had not yet been completed, but as the Paper had been promised, its Authors felt that the members of the Association would be interested in its details so far as they could be stated at the moment.

Finally, said Mr. Walker, he would like to emphasize that it was desirable that much more investigation should be made into such an important matter as the discovery of the simplest and most efficient method for the recovery of by-products of carbonization. Such processes would not be regarded post-war in the same manner as they were during the pre-war period. A realization of the extreme importance of the coal supplies had actually struck down to the very roots of the national outlook, and there was every reason to be optimistic with regard to the future of benzole recovery. Great progress was now being made with regard to the use of plastics, and there had been an increase in the production of raw materials for plastics up to 80% on pre-war requirements. Therefore the place of benzole, even taking into consideration questions of price, would be definitely established in the future, and the fact could not be too strongly emphasized that it was upon the Junior technical Associations that the post-war outlook and activities would depend.

Mr. **H. C. Applebee** explained that in the tables incorporated in the Paper the percentage recovery was not shown. Some of the members present would be accustomed to think of a benzole plant in terms of the recovery percentage. The first item of the second table, 4.22, represented a recovery of something like 98%. Taking the items A, B, and C together, omitting D, the members would see that the average recovery was 4.07, which represented 94.7%. The last item of the group was omitted because it came under different conditions, and would not be fair if applied to the general average. The first two groups, roughly down to G, taken together, showed an average recovery in the order of 90 to 92.5%, while the average benzole recovery was somewhere in the region of 3.7. He could not be more precise in his statement because the many interferences made it difficult to arrive at an exact average, but it might be assumed that the results stated were approximately correct.

Speaking in general terms, he could say that as the make of benzole per ton of coal fell, the percentage of toluene in the crude benzole rose, so that the amount of toluene recovered per ton of coal was constant throughout the whole of the series at just a little over 0.4 gallon per ton. This was important when one of the primary objects of benzole recovery was to recover toluene. The implication was that if the recovery per ton of coal was reduced there was no sacrifice of toluene within the limit to which the Authors of the Paper had proceeded, at any rate. A further point was that the condensed water, to which reference was made at length in the Paper, was now rejected and the making up, so far as it was necessary, was done with fresh town water.

Mr. **C. R. Wilkin** (Manchester) said that perhaps there appeared to be an indication in the Paper that an excessive amount of trouble had been experienced in the operation of the plant. This would be a somewhat unfair idea to adopt, because it must be borne in mind that the plant had been erected in wartime. Many of the points which had been mentioned were minor ones which would, in normal times, have been put right immediately by the contractors. In wartime it was necessary to tolerate and, in fact, not to mind tolerating, minor inconveniences as long as it was appreciated that the contractors would have dealt with them promptly at another time. He was quite satisfied with the way the plant was working, and there would doubtless be some interesting results achieved in course of time. The call for utmost gas output at the present time had not permitted the benzole plant to be run all-out, but it was hoped that within the next few months it would be permissible to do so.

Mr. **H. C. Applebee,** dealing with the point respecting sulphur reduction, said it would be noticed that the carbon had been purposely worked much longer than others who were working activated carbon plants had done. The reasons for doing so had been explained. The result was that the sulphur extraction was very much lower at the end of the series than at the beginning, and much lower than a great many people anticipated. If the carbon had been rejected at the usual point, when the benzole recovery had fallen to something in the order of 3½ gallons to the ton, the sulphur reduction would probably have been in the order of 50% on the average. It was quite correct, of course, that modern oil-washing plants with vacuum distillation and, for want of a better term, excessive oil-washing did get very big reductions in sulphur content. It should not be thought that the way in which the Rochdale Road plant had been worked was necessarily the best. They might not continue to work in the same way at all, as far as he himself was concerned, but he thought that a reduction in sulphur content of something in the order of 50% might be counted on. The normal benzole plant did not reach anything like such a sulphur reduction figure. It was to the credit of the plant that the sulphur reduction was as high as it proved to be.

He felt that he stood very much alone in regard to this point, and many gas engineers had criticized him for the attitude he had adopted, which was that it was not wise to tie up the question of sulphur reduction with benzole recovery. It might be likened to a useful incidental, but they should not be tied up too tightly, or undesirable complications might ensue.

Mr. **R. Walker** remarked that the actual labour costs represented one-third part of a man per shift. The operator was engaged in looking after the concentrated ammonia plant as well as acting as syphon attendant and devoting some attention to normal purification. He would have to be engaged in and about the works in any case.

Mr. **T. G. Lewis** (Southport) noticed that the engineering staff at the Rochdale Road Works considered it advantageous to convert their benzole plant from an oil-washing system to one of activated carbon. They had specified their reason for doing so—namely, that the possibilities of an activated carbon plant were numerous. It was possible, for example, over a period of several months to have a recovery of 94.7% of the total benzole and light oils in the gas extracted. This was a very high figure compared with oil-washing practice, but there were also the advantages mentioned by Mr. Applebee in the removal of sulphur, which was a most important factor. At Southport it had been reduced to as little as 6 grains, and they were now between 6 and 9 grains.

It has been proved most profitable to work the Southport plant to the full capacity at all times. Therefore they made it a policy to change the carbon after the extraction fell below a figure of 3.5 gallons per ton. They could work for quite a long period making 3.8 up to 4.2 gallons per ton of coal. The 4.2, as Mr. Applebee had stated, was when the carbon in the adsorbers was new. The Southport plant was not controlled altogether on the basis of the calorific value of the gas leaving the plant in order to ascertain when the carbon requires changing. A service pipe was taken from the outlet of each unit into a test room, where gas samples could be taken and where a flat flame burner on the outlet of each unit burned. Any change in the luminosity of the flame showed something amiss with that particular unit, and as the flames showed a general increase in luminosity so the adsorptive capacity of the carbon was diminishing, and the adsorption cycle was adjusted accordingly.

As the plant was left without supervision during the greater part of the day they had a selenium cell unit supplied by Radiovisers, Ltd., Manchester, which operated a klaxon horn when the predetermined intensity of illumination of the indicator flames occurred, as a warning that something was amiss in the benzole house.

When the plant was working at 3.5 gallons per ton, the cost of carbon at Southport was about 0.6d. to 0.7d. per gallon. They were in much the same position as that mentioned by Mr. Applebee in the changing of carbon. It had to be emptied through two holes in the bottom of the adsorbers, and allowed to run into the drums underneath the adsorber. Difficulty was experienced with dust, and there was also the human factor to be considered. The men demanded masks, dirt money, and dust money.

Messrs. Sutcliffe, Speakman & Co., Ltd., had now installed a vacuum system which sucked the carbon out of the adsorbing chambers by opening the top covers and inserting a suction pipe, and discharged it into a receiver. When the receiver was full it discharged the carbon into empty drums. When the adsorber is empty the process was reversed. The carbon was drawn from the drum container into the receiver and discharged into the adsorber. A very important point was the elimination of a considerable quantity of dust in handling the carbon. When certain modifications of the vacuum system had been made it should speed up the charging and discharging process considerably.

In dealing with the operating costs, some consideration should be paid to the amount of gas adsorbed, or utilized, in the benzole plant. It was stated in the Paper that this amounted to approximately 2,000 cu.ft. per ton of coal. The benzole plant should bear the charge for the gas adsorbed. This should be added to the cost of the benzole, and then it would probably be found that the cost would be in the neighbourhood of 6d. instead of 2.69d. per gallon.

He was aware that it had been difficult to operate the Rochdale Road plant owing to war conditions and conditions on the works, but since the plant had half paid for itself in six months, it was obviously profitable to make as much benzole as practicable out of the gas, particularly when it could be made for such a low figure as 2.69d. per gallon.

Mr. **R. Walker** thought it had been made clear in the Paper that the details of costs represented merely operating costs. To find the actual net balance, it would be necessary to refer to the actual coal used, to convert it into benzole terms, and then work out the increased production of coke, taking, of course, the question of steam and everything else into account. The ideal way to arrive at the balance was to make up the loss of gas due to benzole production by maintaining a constant output from the plant. If a plant of 4½ millions was being operated, which dropped to 4½ millions, the loss should be brought up by means of benzole recovery and by increasing the throughput on the plant. Some reservations, however, must be borne in mind. The first was the heat capacity of the plant. The Rochdale Road plant, owing to war conditions, had been operating to the fullest extent since the commencement of hostilities ; therefore they did not attempt to bring out as full a balance as was desirable. In order to state the economics of the matter, capital costs and operating costs had been included.

The policy of operating the carbon to the limit had been adopted merely for the purpose of the Paper and for acquiring information. The experience of Mr. Lewis would be taken into the fullest possible consideration—namely, that 3½ gallons was the most economic range of working practice.

Everything which could be stated either for or against the plant had been recorded in the Paper, and if it could be said that this had appeared to place the plant in a rather bad light it had been done purposely. Mr. Howell and Mr. Applebee had been asked not to keep anything back. It was to be hoped that any member of the Association who could provide similar information with regard to oil-washing would also state all the pros and cons, because very often both sides of a picture were not presented for consideration. Unless this was done, it would be very difficult to make a complete assessment, and arrive at a really sound judgment as to which type of plant was really the best.

He understood that Mr. Holton had previously considered the question of carbon recovery, and it was found at Rochdale Road that one of the features of the design was that there was very little back-pressure. It was a very attractive arrangement, including the design of the adsorber. In the case of the London plants, they insisted upon driving the whole of the gas right through the carbon by means of a booster. This was undesirable, as it involved extra cost and attention all round. The Rochdale Road plant had never needed any greater attention with regard to back-pressure even when the plant settled down.

Mr. **Lewis** (Southport) said that the yield of benzole at Southport, working at 3½ gallons, ran out at about 7 to 8 gallons per pound of carbon. With regard to the possibility of the carbon taking up and then giving off H_2S, on one occasion a slight trace was found to be coming to the benzole plant. It was thought that the nickel steel divisions in the adsorbers had acted as a catalytic base, and had reacted with other sulphur compounds and formed H_2S. On the next occasion that the adsorbers were emptied for the changing of the carbon, the nickel steel portion of the adsorbing unit was painted with a cellulose varnish; since that day no trouble has been noted with H_2S on the outlet of the plant.

Mr. **R. Walker** remarked that there had been some experience of H_2S in the case of the London plants. Perhaps Dr. Barash could impart some information upon the subject. He agreed with Mr. Applebee that it was necessary definitely to be prepared to recognize the work which was done by removing the sulphur from the gas simply by transferring it to the benzole and putting extra work and duty on the rectification of the benzole. Although it was quite true this might not be the best way of removing the sulphur, of course the primary object of the plant was not sulphur reduction. Other methods would probably be adopted later on for the removal of the organic sulphur. The fact that H_2S could be formed was perhaps due to the iron present in the adsorber under certain conditions. He understood that research work was now proceeding in the conversion of the organic sulphur compounds into H_2S and removing them as H_2S.

Mr. **A. Healey** (Oldham) said that the Paper was a valuable addition to the literature on benzole recovery. It would be most useful to the engineer who was contemplating embarking upon the process, or to the technician who had to operate the plant. Mr. Walker had mentioned that there was a very low pressure drop across the plant. Could he state what it actually was? What was the average consumption of steam per gallon of benzole recovered? It appeared to be somewhat indicative of the trend of the times that the discussion had turned so much upon the question of sulphur removal, and it did appear to be impossible to consider benzole removal without taking into account the removal of sulphur also.

He was inclined to agree with Mr. Applebee when the latter stated that benzole recovery should be attempted separately from sulphur removal; and taking some of the figures given, he would say that the benzole quoted in the Paper came under the N.B.A. Grade C. If the sulphur was removed, as was being done successfully elsewhere, in a catalytic sulphur-removing plant, then the benzole would probably fall into Grade A and the price would be improved by 1.8d. per gallon. This would work out at 0.07d. per therm of gas made, and the increased price would go a substantial way towards paying the cost of separate sulphur removal. The point that sulphur removal should be made independent of the economics of benzole removal was not quite so important at the moment, but it might become important if benzole became less valuable as a by-product. Therefore, perhaps a separate plant would be an advantage.

A further point arose in regard to naphthalene. It appeared from the Paper that when the plant was not operated at full capacity some naphthalene passed forward. This seemed to place the plant at a disadvantage compared with an oil plant, where a wide variation of benzole output could be secured with, at the same time, substantially complete naphthalene removal.

Mr. **H. C. Applebee** said it was quite correct, as had been pointed out, that when the activated carbon plant was shut down such naphthalene as there was in the gas inevitably passed forward, whereas with an oil plant, even if the rotary gear was not working, there was a sufficient body of oil to prevent the naphthalene passing. They had been extracting as little as 2 gallons per ton with the activated carbon plant and the naphthalene was still held—*i.e.*, no naphthalene passed through the adsorbers. This was some sort of consolation, because even on low benzole makes the naphthalene was still being extracted.

In reply to Mr. Healey, he would confirm that in benzole recovery by any process the more benzole was taken out the lower the grade of benzole. With one of the latest types of oil-washing plants designed to remove sulphur from the gas the sulphur remained in the benzole, whether it was an oil distillation vacuum plant or any other. In other words, the more sulphur was taken out the more benzole was recovered. As Mr. Healey had stated, the price would alter, the difference between Grade A and Grade C being 1d. to 2d. per gallon. He had come to realize that this was not a serious objection. There were processes available for rectification which very easily dealt with relatively high sulphur contents, so that no one need be deterred from installing a plant of the type described in the Paper.

Mr. **Walker**, referring to Mr. Healey's point about the consumption of steam, said it was approximately 40 lb. per gallon; the highest pressure resistance was 4½ in. and the average was 2 in.

(*To be continued*)

S.B.G.I. Junior Awards

The Council of the Society of British Gas Industries has again this year awarded Silver Medals to each of the Junior Gas Associations for the best papers adjudged to have been presented during the year by their members at a general meeting.

Twelve papers were submitted by five Associations for adjudication. They were of a high standard. A list of the awards follows:

Manchester and District Junior Gas Association.—J. C. Hogg, of Stretford, for Paper on "Treatment and Circulation of Ammoniacal Liquor on a New Works."

Midland Junior Gas Association.—S. C. Bentley, of Oxford, for Paper on "The Design and Operation of a Gas Liquor Concentration Plant."

Scottish Junior Gas Association, Eastern District.—J. R. Denoon, of Edinburgh, for Paper on "Mobile Gas Producers."

Western Junior Gas Association.—S. A. J. Horrod, of Swindon, for Paper on "The Future for Gas-Works Products."

Yorkshire Junior Gas Association.—F. H. Nicholls, of York, for Paper on "Future Developments?"

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Products Prices—Stocks and Shares

The London Market May 15.

A new Government Order came into effect on March 1 controlling the price of Benzole and Coal Spirit and replacing the Control of Coal Tar Naphtha and Xylole Order, 1943.

The Order is known as the Control of Benzole and Coal Spirit Order, 1944 (S.R. & O. 1944, No. 172).

By this Order the price of Motor Benzole is fixed at 2s. per gallon. The Order also lays down the method of evaluating Crude Benzole.

The Order also calls for periodical returns to the Ministry of Fuel and Power from all producers of Crude and Refined Benzole.

The only item of interest in connexion with the Coal Tar products market is the issue of Government Order designated the Control of Toluene (No. 4) Order, 1944 (S. R. & O. 1944, No. 170), which contains an amendment of the Control of Toluene (No. 3) Order, 1943.

Prices of Coal Tar products are unchanged.

The Provinces May 15.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 11d. to 2s. 1d., pure, 2s. 7½d. (controlled by the Control of Toluene No. 3 Order, dated July 14, 1943, operative from July 20, 1943). Benzole and Coal Spirit, also Coal Tar Naphtha and Xylole, are now controlled by the Control of Benzole and Coal Spirit Order, 1944, dated Feb. 18, 1944, S. R. & O. 1944, No. 172, operative from March 1. Carbolic acid, 60's, naphthalene, anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.), and strained anthracene oil controlled by the Coal Tar Products Prices Order, 1943, dated Oct. 20, 1943 (S. R. & O. 1943, No. 1528), operative from Nov. 15, 1943.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Scotland May 13.

Export business is more difficult meantime, but home demand is maintained.

Refined tar*: Yield to distillers is 4½d. per gallon *ex* Works naked. Creosote oil: timber preserving quality,* 5½d. to 6½d.; hydrogenation oil,* 5⅞d.; low gravity or virgin oil,† 7¼d. to 7½d.; benzole absorbing oil,* 6½d. to 8d. per gallon. Refined cresylic acid* is 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha†: 6½d. to 7d. per gallon. Solvent naphtha*: Basic prices delivered in bulk, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 2d. per gallon. Pyridine†: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

* Price controlled. † Uncontrolled.

Stock Markets opened the week with a firm tone although a little quieter. British Funds remained steady throughout, and at one time more attention was given to rubber shares. Heavy industrial and brewery shares were prominent among industrials.

More inquiries were made for gas stocks, and with supplies short any transaction was sufficient to cause improvement in value. The stocks of the two Companies operating in India both strengthened, Bombay closing 1s. 6d. higher and Oriental 4½ points up. A feature was the sharp rise of 15 points in East Surrey "B" stock to 105½. A slight reaction took place in Imperial Continental ordinary, the only drop during the week.

The following price changes occurred during the week:

OFFICIAL LIST

Associated Gas & Water Undertakings Ord. (x.d.)	21/6—22/6	May 8
Ditto Deferred (x.d.)	22/6—23/6	"
Ditto 4½ p.c. Red. Cum. Pref. (x.d.)	19/9—20/9	"
Ditto 4 p.c. Red. Cum. Pref. (x.d.)	19/6—20/6	"
Ditto 4 p.c. Irred. Cum. Pref. (x.d.)	17/9—18/9	"
Bombay	30/—32/—	+1/6d.
British 4 p.c. Red. Deb.	95—100	+3
Cape Town 4½ p.c. Cum. Pref.	70/—90/—	+5/—
Commercial 3 p.c. Deb.	70—73	+1
East Surrey "B"	103—108	+15
Gas Consolidation 4 p.c. Red. Cum. Pref. (x.d.)	18/—20/—	May 8
Imperial Continental	85—90	−1
Oriental	140—145	+4½
South Metropolitan Ord.	84—87	+3
Watford 3½ p.c. Red. Deb.	95—100	+5

SUPPLEMENTARY LIST

North Middlesex 5 p.c. Pref. (x.d.)	105—110	May 8

PROVINCIAL EXCHANGES

Liverpool 3½ p.c. Red. Deb.	95—100	+2
Sheffield Cons.	145—147	+1

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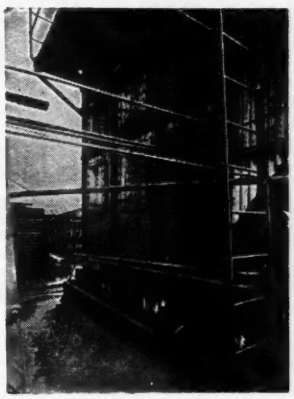

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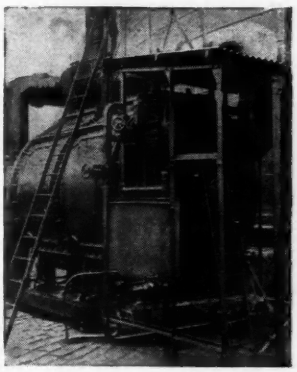

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